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Psychological Bulletin

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CONTENTS

Articles:

The Obtaining of Information: Psychology of Observation and Report: G. M. Whipple, 217.

General Review and Summary:

Reading: E. H. Cameron, 249.

Special Reviews:

Stanford Revision, Pintner's and Paterson's Performance Tests, Pintner's and Anderson's Pictorial Completion Tests, Pintner's Mental Survey: F. N. Freeman, 251.

Notes and News, 256.

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THE

PSYCHOLOGICAL BULLETIN

THE OBTAINING OF INFORMATION: PSYCHOLOGY OF OBSERVATION AND REPORT[1]

BY GUY MONTROSE WHIPPLE

Carnegie Institute of Technology

1. *Information is a Normal Precedent to Action.*—If we could imagine an animal without any senses, it would be hard to imagine what would ever induce this animal to do anything at all. It would never see anything nor hear anything nor smell anything nor taste anything nor feel anything that would make it want to move, either to secure food or to avoid an enemy. On the contrary, really our behavior is virtually under constant regulation and direction from our senses; we move toward what attracts us; we run from or attack what we fear or dislike. The more complete this guide from the senses, the more information we have, the more successful we may expect to be. For the most sagacious action we need to possess as complete knowledge as is feasible concerning the conditions that surround us.

2. *The more complex the action possible, the more complex the prerequisite sensory machinery.* The jelly fish and the oyster can do but little after all; they need, then, but little information from their sense organs. What advantage would accrue to the oyster even if he could have a pair of ears grafted upon him? But we human beings possess a most elaborate set of muscles; we can move our bodies in hundreds of ways that the jelly fish and oyster cannot. To get the best efficiency from this elaborate machinery for moving, evidently we need a correspondingly elaborate machinery for sensing. And we do, indeed, find that the machinery possessed by human

[1] Outlines of the Study of Human Action for the Students Army Training Corps, Section VI.

beings for getting information about what is happening in the world about our bodies (the various sense organs), and especially the machinery for storing up this information (the cells of the brain itself), is far and away superior to that possessed by other and less complexly constructed animals. The same thing is true also of the machinery for making records of this information and for transmitting it to others (gesture, handwriting, speech, reading, etc.).

3. *The analogy holds true by extension with groups of men, like an army, organized for a common purpose.* When a group of human beings gets together and acts more or less as a group many of the principles that apply to the behavior of one person alone apply also to the group. An army is a group of this sort. It is no mere fanciful term to say that an army is an organism; it is a living thing, organized for a definite purpose, having definite ways of behaving and (what we are now interested in) having definite need of information to guide its movements.

In addition, therefore, to motor transports, supply services, quartermaster and ordnance departments, infantry, cavalry, machine gun battalions and all of the other elements in this huge organism, there must be some sort of mechanism for "sensing," for getting information that will guide the activities of the whole affair just as your steps along a rough path in the dimly lighted forest are guided at every instant by the help given through your eyes, through your ears, through the "feel" of the ground to your feet, and even perhaps through your nose. This sensory mechanism in the army is illustrated in its intelligence sections, its scout service, its balloon and aeroplane observers, its spies, its quizzings of prisoners of war, its reports from officers, its signalling systems, and the many other methods by which information concerning both its own doings and those of the enemy is gathered, sifted and fitted together, finally to emerge in the guise of complicated orders for the movement of troops, guns and supplies. This information guides the activities of the whole military organization.

4. *Modern military conditions demand the utmost in complexity and efficiency of the intelligence service.* Every one knows that the great World War in which we are now engaged exceeds all previous wars in magnitude of operations, in elaboration of detail and in complexity of the agencies made use of. Every device known to

modern science has been seized upon and thousands of workers are laboring to invent and perfect new ones. Our analogy holds here, too. Just as the individual man with his complex motor mechanism is equipped with a sensory mechanism much more effective than that of animals with a simpler sphere of movement, so our armies in this extraordinary combat need the most effective intelligence service that our brains can devise. We need cite merely the use of the aeroplane and the wireless as illustrations of the utilization of the most recent inventions for increasing the effective range of vision and speeding up the transmission of information. Just suppose that some inventive genius had been able in the Civil War to equip one side with a squadron of airplanes and a wireless signalling system, can we doubt that the tremendous advantage that would have resulted in the gathering and forwarding of information would have speedily brought victory in its train? No wonder that the airplanes are termed the "eyes of the artillery" and that the gaining of supremacy in the air (which means, of course, not only getting information freely of the enemy's movements but also preventing them from getting information of our own movements) is a most powerful aid to victory.

5. *Inefficiency in the intelligence service is correspondingly serious under modern military conditions.* If we human beings gain much by our finer nervous organization we also pay the penalty of being more liable to damage and more hampered by the damage if it occurs. We know how true this is of all sorts of machines. To drop a high-grade watch is more costly than to drop a dollar alarm clock. Pneumatic tires permit faster speed and more comfort than solid tires, but they are liable to puncture and when punctured are less efficient than a solid tire. The very bigness and complexity of modern military organization increases tremendously the need for watchful care over its parts. If the intelligence service breaks down, the army is like a man with his senses clouded by some stupefying drug. What perhaps is worse, if errors are reported as truth and accepted as truth, then the army is like a man who is being unwittingly misled by an illusion. It is often worse to think you know when you don't than it is to be ignorant and know you are ignorant. In fact, not to know you don't know is often the acme of foolishness.

6. *Despite all the refinements of mechanism that science has invented the collecting and interpreting of information must remain a human*

activity. Field glasses, to be sure, bring distant guns near the eye; periscopes permit the trench fighter to watch his enemy without exposing his head; the modern camera reveals a mass of details that would escape the best observer; and microphones when properly constructed and adjusted reveal the faint throbs of a distant propeller. Nevertheless, it is always some human being that looks through the glass of the periscope, that unravels the meaning of the photograph, or that listens to the microphone. It is always some human being that seeks to understand the meaning of what is seen and heard, some human being that writes down this meaning or speaks it or signals it by gesture or wigwagging or heliograph; it is some other human being that reads what has been written or hears what has been said or receives the signalled message.

And we are told, and it is true, that "to err is human." In every link of this chain of processes necessary in gathering and reporting information there lurks the possibility of inaccuracy. It is the business of the psychologist, who studies human nature, to point out to you where these mistakes are likely to occur and to help you to avoid them, just as it is the business of the physicist and the chemist, who study the properties of substances and the ways of combining them into various instruments and processes, to tell you how to use these aids in gathering information with the lowest possible margin of inaccuracy. This section aims to show where human beings most often go wrong in the use of their senses and especially in bringing in such reports as are required by the intelligence service of our army in the field.

7. *The first condition for getting accurate information is the possession of reasonably efficient sense organs.* It is true that information has to be "digested" to be of value; that all observation has to be guided from within by an intelligent brain; a baby does not "observe" in the sense of making systematic and planful scrutiny of objects and events about him; he doesn't yet know what to look for. But on the other hand, an intelligent adult has to get his original stock of material through his sense organs. Our ideas about colors, odors, sounds, the way things feel and taste are all ideas that are based on experiences obtained through our senses. We know of no colors we have not seen, of no odors we have not smelled. The man born blind cannot even imagine the blue of the sky. We do not mean that only persons with the most exceptional equipment of sense organs can be made into competent observers,

because so much does depend on knowing what to look for, what to listen to. But we can say that, other things being equal, the possession of sharp senses is a decided asset for the obtaining of precise information. The more difficult the conditions under which the information is to be gathered, the more important it is to use observers with superior sensory acuity. Attention has been called in Section II to the wide range of individual differences in all forms of mental equipment. We need to note in the next few pages how some of these individual differences in sensory capacity may affect the usefulness of men chosen for observation work.

8. *Men differ in their capacity to see colors.* About four men in a hundred are color blind. Certain reds and greens, especially tints and tones of these colors, when combined with other colors, like reddish browns, bluish or yellowish greens, or bits of red and green when seen briefly or dimly are not seen as normal persons see them, and consequently reds and greens are often confused under these conditions. Since this kind of visual defect is inborn and incurable, it is important that the color-blind man be not placed in positions, as in naval look-out work or in railway service, in which the confusing of red and green signals might lead to disaster. Tests to ascertain the presence of defective color vision are quickly and readily made.

9. *Men whose color vision is perfectly normal differ much from one another in visual acuity, that is, in the sharpness of vision.* A famous physicist is said to have remarked that if his instrument maker brought him an optical device as poorly made as the human eye, he would discharge him on the spot. It is true that the eyes of all persons are subject to various deficiencies when compared with instruments of precision. It is likewise true that, even when these defects common to all eyes are disregarded, even then flawless vision is extremely uncommon. Nearly every person has a slight defect of shortsightedness or farsightedness or of astigmatism. The ordinary letter tests of the oculist and optician are designed to reveal the presence of still more obvious degrees of these defects. A slight degree of farsightedness may produce no reduction in the keenness of vision, but merely render its possessor liable to eye-ache or headache. Wearing glasses will usually eliminates this sort of disturbance. A moderate degree of shortsightedness, however, is not likely to produce eye-strain or headaches, but does cut down

the clearness of all objects located more than a few feet away from the eyes. Here again, properly fitted glasses will usually restore vision to normal or nearly normal efficiency. Men who need to wear glasses to get comfort or clear vision mav, accordingly, see just as well with their aid as other men whose eyes are pronounced " perfect," but it is obvious that men with glasses make poor risks for some branches of the military service in that their power to see clearly would be lost if their glasses should be lost or broken.

It is also true that men differ measurably in the sensitivity of their vision, quite apart from these differences that have just been mentioned. For special work it might be distinctly worth while to select men possessed of the highest degree of sensitivity of the retina.

10. *Again, men without defects of color vision or of visual acuity and who are equally good at seeing in the daytime may be quite unequally good at seeing in the nighttime.* This is because the retina of the eye (which corresponds to the sensitive film of the camera) is really made up of two distinct sets of sensitive substances—the one especially designed for the high illuminations of ordinary daylight seeing, the other especially designed for the low illuminations of twilight and dark seeing. There are some men whose night eye is so poor as to be almost useless; there are others whose night vision is exceptionally good. It is obvious that in a group of men selected for night patrolling there ought to be no men of very poor night vision and at least some men of extra good night vision. Naturally, as has already been noted, it does not always follow that the man with the keenest vision is the very best observer; men with only average eyes may be trained to make reliable first-class observers.

11. *To get the best results with the night eye it is necessary that the retina of any observer should have a certain amount of time to get used to the dim illumination.* Every one knows that in coming out of a brightly lighted room the night seems pitch black, but that little by little our eyes get used, or "adapted," to the darkness and that objects previously invisible begin to emerge. But not every one knows that this process of "dark adaptation" goes on for as long as an hour and that there is especial improvement between the 10th and the 30th minute. It follows from this that for the best results, visual observation at night ought to be undertaken after the eyes

have been kept from all bright light for half an hour or more. Night patrol workers ought not to look at flares, rockets and other bright illuminations if they wish to have their eyes in good shape for seeing dimly lighted objects for several minutes thereafter. It would probably pay to use only one eye if bright objects had to be looked at, so that the other might have its dark adaptation preserved.

12. *The twilight eye sees better out of its "corner" than straight ahead.* In ordinary seeing we always turn our eyes to look directly at the object that we are observing, but experiments show that at night the eye is very much more sensitive to faintly visible objects that are seen at one side of the direct line of regard, namely, that are seen in what the psychologist calls "indirect vision." It would be quite possible, then for some object to be "seen" by the "tail of the eye" which could not be seen when the gaze was turned directly upon it. Men destined for night patrol work might profitably be trained to give attention to things seen in indirect vision.

13. *The twilight eye sees no colors.* The French have a saying: "la nuit tous les chats sont gris,"—"all cats are gray at night." This saying calls attention to one further peculiarity of night vision; unless the source of light is strong enough to excite the daylight eye, all objects appear colorless in night vision, for the twilight eye has no mechanism for responding to light waves of different lengths with the series of color sensations of ordinary vision.

14. *Men differ from one another in their acuity of hearing and the acuity of the same man differs at different times.* The testing of hearing cannot be carried on as conveniently nor as precisely as the testing of vision, nor have we any well defined standards of what constitutes normal hearing. Nevertheless, it is possible by tests in which numbers are whispered at given distances from a group of men to pick out those whose hearing is peculiarly good or peculiarly poor. These tests will often demonstrate that some men do most of their hearing with one ear, just as some men do most of their seeing with one eye and never discover it until they happen to be tested. It is worth remembering, too, that the sensitivity of the ear is almost always reduced when there is inflammation present in the nose and throat. For this reason men who are suffering from a nose cold or a sore throat ought not to be assigned to duties

demanding the listening for, and locating of faint sounds, as, for instance, in using the hydrophone.

Here, again, as in the case of the eye, training is important. To be a "good listener" for military purposes means more than being able to detect very faint sounds; it means also understanding what they may mean, from what direction they come; it means also the ability to disregard the multitude of faint sounds, like the little noises attendant on breathing, and the "pumping" of the blood in the ears, that are unimportant and that are literally not heard under ordinary conditions.

15. *Similar individual differences exist in the sensitivity of the other sense organs.* It is seldom, perhaps, that military activities demand men with specially sensitive noses or tongues or fingers, but it will be understood that in these senses, too, men differ from one another in their natural capacity. Every one has heard of the work of professional tea tasters and wine tasters and we occasionally find men whose sense of smell is well nigh superhuman, who, for instance, can identify metals or the coats of their acquaintances by smell alone. As for the fingers, we know that workers in factories that demand sorting articles by touch differ decidedly in their delicacy and speed of work. In teaching men who have become blinded to read with their fingers the raised print for the blind we encounter similar individual differences; some learn rapidly, some slowly and this quite apart from general mental ability or previous ability to read with the eyes. Again, there exist differences in the sensitivity of what are called the "semicircular canals"—structures closely associated with the internal ear but sensitive to changes in bodily position instead of to sound waves. When these canals are stimulated, they produce the sensation of giddiness or dizziness. It was supposed in the earlier months of the war that successful aviators must be men who did not readily experience this sensation and on that assumption many men were rejected from the aviation service after tests with revolving chairs, turntables and similar devices for producing giddiness. The more careful experimental studies of psychologists both in America and England have shown that success or failure in aviation is not closely associated with the absence or presence of sensations of dizziness.

16. *Under everyday conditions sensory acuity may often be measurably lowered without appreciably impairing a man's general efficiency.*

One reason why men whose sense organs are not 100 per cent. efficient may get along so well that they never suspect their deficiency is that the requirements of daily life are not so rigorous as those set up by the stringent necessities of military activity. Another reason is that a defect in one sense organ is often overcome by the, at times unsuspected, assistance of the other sense organs. A person slightly hard of hearing forms the habit of watching the mouth of the person to whom he is listening, and he also mentally fills in many gaps in the sentence that he didn't fully hear. When you listen to some one who speaks in a foreign tongue, as, for instance, when you try your French in France, you discover how necessary it is to hear every sound, because you cannot then fill in easily from your general knowledge of the language. As for the blind, they learn to use their fingers, feet and ears and perhaps their noses so well in getting about that it has been seriously contended that some of the blind develop a mysterious "sixth sense" that affords them information to guide their steps. And then again, training, while it cannot make any actual changes in the efficiency of the defective sense organ itself, may teach the man to use very skillfully what capacity he does have. We have long been amazed at the extraordinary powers of observation of scouts and hunters of savage and primitive races who guide white men unerringly over ground where no sign of a trail seems to exist or who detect the presence of game or of enemies at distances that seem impossible. Yet Dr. Rivers, an English psychologist, who was able to measure accurately the vision of natives of the Torres Straits and of Patagonia, found their actual sensory capacity no better than that of normal civilized whites. Long experience had developed a special kind of skill in interpreting what was pictured on the retina. These very natives would have found it difficult to find their way about London or to distinguish a flivver from a Packard a half mile away.

17. *In using the sense organs there appear certain illusions, common to all persons, and these, if not understood may lead to false interpretations of what is being observed.* On a sheet of paper draw a line about three inches long. At each end put an arrow head with the barbs about a quarter inch long and both facing inward. About an inch below draw another line just the same length but with arrow heads both facing outward. You will find that, even though you know the lines are equal and deliberately try to disregard the "pulls" of the arrowheads, nevertheless the lines persist in

seeming unequal in length. This is one of the stock samples of "optical illusions," more of which can be found in almost any text-book of psychology or physiology.

There are many illusions of length and distance; there are others that make us see objects out of perspective; there are others that give us wrong notions about the motion of objects. Who has not thought his own train in motion when really it was the train on the next track that was moving by in the opposite direction? A recent writer contends that good swimmers have been drowned by giving up in despair because they thought themselves being swept out to sea by an offshore current when in reality they were affected by an illusion produced by the breaking wave crests sweeping by them towards shore.

18. *In judging the direction from which a sound is coming there are certain illusions that often introduce error into this sort of observation work.* Sit down and close your eyes. Let some one move about noiselessly and snap his fingers or emit a very brief whistle. Try to point toward the source of sound or to describe its direction, *e. g.*, directly ahead, obliquely to the right and above, etc. Notice that sounds coming from any point in the median plane (equidistant from the two ears) are especially hard to locate, whereas right and left are seldom confused. When uncertain as to whether a given sound is in front of you or back of you, let it be repeated while you turn your head and try again to locate it. Try the same thing with the use of a whispered two-place number instead of the snapping of the fingers. Again, let the experimenter stand about two meters distant and snap the fingers of one hand, then of the other in close succession; notice how far apart his hands must be to enable you to distinguish the different directions of the sounds when the experimenter is standing at different places. These experiments may be varied by having the listener cover one ear completely with the palm of his hand. The general principle brought out is that the direction of a sound is judged largely by the differences in its intensity in the two ears, and in wave phase, so that when the source is nearly equidistant, serious illusions may enter into the observations. The application of this principle to scout and patrol work is evident enough.

Another source of error in locating sounds arises from a strong tendency to associate sound with movement. If tests like those suggested just now can be arranged outdoors at night with the

listener's eyes open and several persons, so placed as to be barely visible, coöperate as experimenters, this last-mentioned source of illusion can usually be demonstrated easily. Thus, if *A* moves his hand perceptibly just as *B*, who remains invisible, snaps a twig, the listener is very likely to connect the noise he hears with the movement he sees.

19. *Under some conditions an observer may believe that he has perceived an object when in reality he is the victim of an hallucination.* In the illusions just discussed the observer states that he perceives a certain thing, but we know that a certain amount of error has crept into his statement. His sense organs have been stimulated, but his interpretation of this stimulation is more or less wrong. It will be understood that whenever we perceive anything at all we must to some extent be interpreting what our sense organs actually give us. Suppose a baby and a man both watching a battle; to the baby there would be a confused, meaningless jumble of sounds and sights; to the man these same sounds and sights would have immediate meaning—in short, he would understand what he saw and heard. He could do this because of his experience. The brain contributes to our seeing quite as much as does the eye. If, then, we ordinarily "read into" our sensations much that is not actually there, it will be intelligible how occasionally we might contribute too much or quite distinctly erroneous interpretations. When this occurs, as, for instance, when a man who is wide awake thinks he sees a ghost or has some other supernatural apparition, we call the experience an *hallucination*. An hallucination, then, is a false perception of an object or event when there was no such object or event to be perceived.

20. *Hallucinations may affect any man and are especially liable to occur under abnormal nervous conditions, like extreme fatigue, drugging or emotional excitement.* It used to be thought that a person who had experienced an hallucination was both a rarity and an oddity, but the inquiries of several investigators show that at least one person in every ten will at once admit having mistaken imagination for reality at some time in his life and that most other persons make the same admission after they have had the question explained to them.

When we seek for the conditions under which hallucinations are most liable to occur, we encounter a number of them that are

quite characteristic of military situations. Fatigue, for instance, is a condition that favors hallucinatory experiences; in fact, one of the commonest simple hallucinations is to imagine you hear your name called by some one just as you are falling asleep. In this hallucination, the voice is curiously clear and distinct and seems to come almost from your very ear. Men worn out by battle, whose nerves are either taut with momentary excitement or unstrung in periods of respite, are in a condition that favors the false perception of things that are not present. Various anecdotes from the Front narrate the seeing of visions and apparitions of this hallucinatory sort: Joan of Arc is said to have reappeared to the French soldiery; Christ upon the Cross was clearly seen hovering over the battle field, and so on.

21. *Observation is peculiarly influenced by expectation, so that errors amounting to distinct illusions or hallucinations may arise from this source even when fatigue and emotional excitement is lacking.* We tend to see and hear what we expect to see and hear. Some one in a crowded waiting room is pretty sure to think he hears the whistle of the train that is an hour late and to precipitate a vain stampede to the platform. If you have ever read accounts of the way the professional conjurer "pulls off" the tricks that have mystified you, you surely have been amazed at the simplicity of most of them and of the prominent rôle played by attention. It is part of the conjurer's stock in trade to make you look toward one end of the stage when something important is going on at the other end. Thus, in the familiar scene in which a gold ring borrowed from the audience is being apparently smashed to bits, packed in a pistol and fired at a pile of boxes, only to be recovered later intact and adorned with blue baby ribbon in the inmost box—in this scene the business of pounding up the ring is carried on in the center of the stage at the front and with sufficient flourish to keep the eyes of the audience from the hand of the assistant as it deliberately picks up the real ring from a table at one side of the stage and subsequently sets out the group of boxes properly arranged with the ring inside them.

22. *If the expectant attention is properly directed, however, the efficiency of observation is very greatly increased.* It is hardly possible to exaggerate the rôle played by expectant attention in observation. It is clear, too, is it not, that this rôle may be highly favorable or

highly unfavorable, according as the expectancy is right or wrong. If a sniper is hidden at a certain point and I know that he is somewhere near there and that he is probably camouflaged by a certain kind of coat and hat and that he will fire his rifle if I display something to attract his shot, then I have a better chance to detect his location than another observer who is not prepared by this knowledge of about where to look, when to look and what to look for. Most of the training in observation consists in coaching men in this sort of preparation, in teaching them what to listen for and what to look for—in other words what to attend to. To grasp quickly what things should be attended to is a matter of general mental ability, of general intelligence, not a matter of sharpness of the senses. This is one reason why, as has been noted already, men with superior intelligence and only average eyesight or hearing may make excellent observers. In selecting men for training in the work of intelligence sections the possession of this capacity to grasp explanations quickly is therefore of considerable importance. Presumably men who attain *A* or *B* ratings in the army intelligence tests ought to be much preferred for work in these sections.

Another way, perhaps, of stating the principle of this paragraph is to point out how all of us notice the things in which we are interested and tend actually not to perceive the things in which we are not interested, because to be interested in a thing means that we attend to it readily, naturally and with satisfaction. The experienced aviator hears a disturbing note in the hum of his motor that would pass unnoted as well as unrecognized by the novice, but he might well be found at loss if asked to say whether or not an oboe was being used in the military band that was marching by, this not because he could not be trained to "hear out" the strains of the oboe (his keenness of ear is attested by his hearing of his motor), but because he had no natural interest in that instrument. Notice what events and objects you find yourself "full of" just now that never caught your attention before. You will discover that the moment you get interested in something, you begin to notice it about you as you never did before. You will also discover that the more you know of this thing, the better you can observe it. Generally speaking, persons who are acknowledged to be "good observers" are found to be persons who have a considerable curiosity about the details of things they see and hear and also a good stock of general information about them. They have a habit of observing things. The more they observe, the more they know; and the more they know, the more intelligently they observe.

23. *Even under the most favorable conditions there is a distinct limit to the number of things that can be attended to at once.* Draw on a good-sized piece of cardboard or on the blackboard a rectangle, say 30 cm. square, and in it make about a dozen figures of different sorts, as an arrow, circle, a triangle, an ellipse, an acute angle, a letter T, a figure 8, etc. Keep this concealed from a group of observers until they are warned to give close attention and be ready to draw or describe all they have seen. Have it understood that the drawing will be seen just 5 seconds. Note the number of drawings correctly reproduced by members of the group of observers.

Assemble on a table 12 small and familiar objects, such as a ruler, a match box, a pen, a knife, a penny, a key, a postage stamp, a cigar, a bit of cloth, a piece of chalk, a pebble and a leaf. Cover these with a cloth; let observers stand about the table, four or five at a time; explain the test; remove the cloth just for 5 seconds then let them about face and write down the names of as many articles as they can recall.

Put on the blackboard or on a sheet of cardboard a column of 10 nonsense syllables, like these: *tob, arg, ime, arl, elt, vid, ool, bli, ild, vel.* Keep them concealed until ready for the test. Explain that you will read a paragraph on the subject of coincidences and that when the reading begins, there will be displayed a column of 10 three-letter nonsense syllables, like *ept* or *aum* (write these samples). The observers are to do their very best and try seriously to remember as many as possible of the nonsense syllables. Nothing is to be written during the reading. Warn against giving way to laughter during the trial. Read the following paragraph distinctly and not hurriedly:

"Coincidences in names are of such frequent occurrence as to be familiar; but some of them are surprising. Daniel Webster married Catherine Le Roy. Not very long ago in Boston a suit was noticed, the parties to which were Daniel Webster and Catherine Le Roy. The First Unitarian Church of the city of Baltimore was attended for more than forty years by a gentleman recently deceased. From that pulpit he heard discourses by Doctors Furness, Bellows, Sparks, Burnap, and Greenwood. Two were settled pastors; the others, eminent men who appeared on various occasions. In Guilford, Conn., till within a few years, the Second Congregational Church had had but three pastors in its entire history—Root, Wood, and Chipman. This society resulted from

a disturbance in the First Church, and when Mr. Root was about to be installed, one of the members of the First Church, with equal bitterness and wit, suggested a text, 'And I saw the wicked taking root.' Not many years since the city of New York had attention drawn to the names of four great criminals whose names contradicted their characters—Charles Peace, who had personated a clergyman, was hung for murder in England; Angel was the name of a defaulting cashier; John Hope, of one of the robbers of the Manhattan Bank; and the Rev. John Love was deposed for crime. On the day that the Hon. John P. Hale died, the schooner John P. Hale ran ashore on a reef called Norman's Woe."

From these three experiments the following results will emerge:[2] (1) Unless the various objects can be recalled by scheme of grouping (as associating pen, pencil, chalk and postage stamp with the idea of writing), the average number of impressions grasped in the first two tests will be four to seven. (2) Many observers will notice that just at the moment the exposure of the forms or objects ended, they felt that they had grasped more than they can recall when they seek directly afterward to write them down. (3) Many observers will notice that they recall even things seen much better by thinking of the names of these things than by trying to remember how they looked. (4) Observers who have high scores will almost invariably be found to have hit upon some clever scheme of combining the objects into groups. (5) In the table test individuals will range from as few as 3 to as many as 10 objects, averaging about 6. (6) In the third test there will be much difficulty and confusion; attention will never be given keenly to both the reading and the nonsense syllables at any one moment, but rather there will be an alternation of attention, now to the one, now to the other, or else the observer will give up entirely the attempt to distribute or to alternate his attention and will be able to report only on the syllables or on the paragraph. This general result will hold true under various analogous conditions, *i. e.*, it is practically impossible to give really keen attention at any instant to more than one thing if the things are of different kinds and especially if one of these things is something to be looked at and the other something to be heard. If you will think of situations where this rule seems not to hold, you will discover that they are situations in which one of the

[2] The experimenter will find further suggestions and much additional discussion of these tests of attention in the writer's *Manual of Mental and Physical Tests*, Baltimore, 1914, Vol. I, Tests 24, 25 and 30.

things can be done more or less automatically, without demanding real attention. You can lace your shoes and listen to the talk of the men about you, but the shoe lacing is not requiring careful attention, or if it should need it for a moment, just then you would lose the thread of conversation.

24. *The degree of attention that can be given is not constant, but varies from moment to moment. Especially for difficult observation, the best attention can be secured only after a preliminary warning.* It has already been shown what an important factor in good observation is found in preparedness, in knowing *what* to look for. It may be added here that it is equally important to know *when* to look, *when* to listen. Experiments in the laboratory bring out very clearly, what after all we know from everyday experience, that even when an observer is supposed to be watching, to be continuously attentive, yet he succeeds better if he gets a warning signal—a "now"—some one or two seconds before he is required to exert his best efforts. The degree of attention that is present appears to fluctuate, to wax and wane. The best observation work is done when the attention wave is at its crest.

25. *The attempt to give continuous attention for a considerable time, especially to watch for objects or events that are hard to observe or whose precise time of appearance is unknown, exacts much effort and tends to develop correspondingly rapid fatigue.* The truth of this assertion is readily demonstrated by simple experiments, as for example, blindfolding several observers and seeking to find out which one first hears the ticking of a watch which will be just barely audible at any moment within the next 20 minutes. Another illustration is to be found in the decided fatigue that ensues upon an attempt to follow for an hour a conversation carried on in a foreign language of which the hearer knows just enough to keep the general thread only if he listens carefully to every word. Or, again, in the decided fatigue that ensues upon a day spent in sight, seeing in some novel surroundings where everything catches one's attention, *e. g.*, the first day spent in a foreign country or at a World's Fair. Men ought not to be expected, then, to carry out difficult, continuous observation work for very long at a time; otherwise the accuracy and completeness of the observation is bound to be reduced.

26. *There are certain things that powerfully attract attention and that must therefore be avoided in the effort to conceal information from*

the enemy. Prominent among them are movement, and change, intense stimuli, unusual things in familiar settings and familiar things in unusual settings. Railway and traction companies have found that a light or semaphore bar arranged to swing back and forth or to rotate makes the best warning signal at dangerous crossings. Crossing gates are painted in black and white diagonal stripes to catch the attention of careless drivers and pedestrians. Electric signs that flash on and off or that simulate movement are found to pay many times over for the cost of the apparatus for producing these effects. An old tin can makes an excellent blind for the termination of a periscope tube if located in an area generally strewn with such debris, but a lone tin can in the midst of a stretch of grass calls attention to its own presence. Many animals escape capture by keeping motionless when their enemies approach, and many others have given valuable suggestions to the camouflage corps by the manner in which their coloration permits them to efface themselves against a background with which they blend so beautifully. This general idea of "protective coloration," as it is called by biologists, is the idea underlying, for instance, the use of various sniper's suits which usually conceal their wearer from the enemy's eye, not by rendering him some uniform gray or "horizon blue" color but by covering him with splotches of broken color that give the effect of irregular light and shade on the background on which he is to lie or crawl.

27. *Whenever any interval of time elapses between the actual carrying out of observation and the recording of it by word or gesture or pen, the accuracy and completeness of the record tends to be reduced by errors of memory.* The original work of observation means, of course, that series of impressions that arise in the sense organs are carried to the brain where they leave some sort of trace, produce some sort of modification of the nervous substance. We know that this trace or modification is relatively unstable, that it tends to disappear, rather rapidly at first, then more slowly. You can recall now in considerable detail what you have been doing the last thirty minutes; tomorrow at this time you will be able to recall many fewer details; a year from now the doings of these last thirty minutes will have faded into oblivion unless some special occasion has led you to rehearse them and to keep the memories polished. Other things being equal, then, the longer the time has elapsed between your conversation and your recall of it, the less complete and the less trustworthy will be that recall.

28. *The most common inadequacies of memory are errors of omission.* Read the following paragraph *straight through two times*, then close the book and write as much of it as you can remember.[3] Use the words of the original when you can, but use your own words if you can't remember exactly those you read.

THE DUTCH HOMESTEAD

"It was one of those spacious farmhouses, with highridged, but lowly sloping roofs, built in the style handed down from the first Dutch settlers, the low projecting eaves forming a piazza along the front capable of being closed up in bad weather. Under this were hung flails, harness, various utensils of husbandry, and nets for fishing in the neighboring river. Benches were built along the side for summer use; and a great spinning wheel at one end, and a churn at the other, showed the various uses to which this important porch might be devoted. From this piazza one might enter the hall, which formed the center of the mansion and the usual place of residence. Here rows of resplendent pewter ranged on a long dresser dazzled his eyes. In one corner stood a huge bag of wool, ready to be spun; in another a quantity of linsey-woolsey, just from the loom; ears of Indian corn and strings of dried apples and peaches hung in gay festoons along the walls, mingled with the gaud of red peppers."

This paragraph contains in all 180 words and approximately 94 distinct ideas. It will be found that no one can recall all of these ideas and that surprisingly large differences appear within any group of men that try it. It will also be found that the difference between the reproduction and the original lies almost entirely in the omission of ideas. The impressions made by the reading have faded or "shrunk," one might say, by an amount that varies with the relative capacity of the individual.

A similar experiment may be devised by substituting for the paragraph some large picture or photograph having a reasonable variety of detail in it.[4] Examine this picture for some 20 to 60 seconds, then try to describe it so fully that a person who had never seen it would have a perfectly clear notion of its appearance. Tests of this sort may be elaborated by any one indefinitely; for

[3] If this test is tried as a group, let some one keep the time and allow 2 minutes for reading the passage through twice and studying it in any way that is wished in what time may remain. Details for carrying out the scoring exactly are given in the writer's *Manual of Mental and Physical Tests*, Part II, page 120.

[4] A colored lithograph entitled "A Disputed Case" is well adapted for this test. It is No. 1235 of the Taber-Prang Art Company's collection and may be purchased conveniently of the C. H. Stoelting Co., 3047 Carroll Ave., Chicago, Illinois. Another bit of material that may be recommended is a "Card of Objects" prepared by the present writer after suggestions by the French psychologist, Binet, and also sold by the Stoelting Co. Suggestions for using these test cards are given in my Test 32, *Manual of Mental and Physical Tests*, Part II, pages 22–29.

example, let three persons (strangers, of course) walk slowly past a group of observers; require from each observer as extended a description as possible of the three persons.

29. *The recall of what has been observed is liable to falsification by erroneous insertion.* If several observers try the experiment with the *Dutch Homestead* selection, it will almost surely happen that some one will add to his description details that were not present in the original paragraph. This type of mistake will usually be even better illustrated in the tests already proposed of describing a picture or a person from memory. Most of the insertions thus made will be found to be of the plausible sort, that is, they might quite well have been present in the thing or event under observation, and most of them will be found to relate to minor details. They represent, therefore, a tendency to fill out memories in such fashion as to make them accord with ordinary experiences. The main ideas are retained fairly accurately, but minor details are erroneously added that are not inconsistent with the main ideas, though they were not actually observed. From this it will be understood that these false additions are peculiarly serious when the observer is trying to recall something out of the usual run of his experience, for not only will he not have observed the details correctly (Principle 21), but he will unwittingly make absolutely wrong and misleading additions to his memories of what he did not observe correctly. And what is worse, he will not be conscious of the erroneous additions. The best way to meet this source of error in getting and reporting information is evidently to caution the observer to be on his guard against the tendency and to quiz him to determine just what items in his account he positively did observe and what ones he merely inferred to be present.

30. *The recall of what has been observed is liable to falsification by substitution.* This source of error is similar to that just described, only by substitution we refer to cases in which, instead of a simple addition of extraneous material, some of the original items are dropped and other items are inserted in their place. Many of the common alterations that characterize our accounts given from memory are of the general nature of substitutions. Thus, I once had an argument with a young lady about the possibility of "table-tipping." She told of a simple experiment that had occurred in her own parlor when, so she said, a half dozen persons were seated about

a light table and succeeded in making one edge of it rise an inch in the air by all concentrating their wills upon it. I expressed polite incredulity and suggested that such a thing might occur easily enough by unconscious pressures and pulls in the hands of the sitters. "That," the young lady retorted, "was impossible because when we exerted our wills upon the table, our hands were lifted off it." "Then I must really declare," I replied, "that your memory of the affair is at fault. You admit that it was several years ago." Whereat she exclaimed: "Here is where I convince you that other people besides psychologists know how to conduct experiments. I wrote down an account of it that very evening and I remember that I wrote about the hands being lifted in the air." She ran upstairs for her diary and finally produced her notes on table tipping, only to read in some dismay: "When the signal for exerting our will was given, we all laid our hands upon the table with little fingers crossing with our neighbor's so as to make a complete circle for the 'magnetism.' Pretty soon one edge of the table lifted several inches into the air!" Here the item "hands-on-the-table" was quite forgotten and there had become substituted for it the item "hands-lifted-in-the-air."

31. *The recall of what has been observed is liable to falsification by transpositions in the time, order and space arrangement of items.* Illustrations of these errors can be obtained by any person by reference to his own difficulties in giving a correct account of any series of events that occurred in rapid sequence. An excellent illustration is afforded in the accounts given in the court room by eye witnesses of an accident or of a street brawl. Absolutely contradictory answers are given by perfectly honest witnesses to such queries as: "Did the engineer apply the brakes before he whistled?" "Who struck the first blow?" "Was the accused standing in front of, or behind his brother?" "Which man went ahead and cut the wire?" "Did the explosion follow or precede the rocket signal?"

Here, again, as in other errors of memory, there is a strong tendency unwittingly to rearrange the order of events to accord with what would be the order under most circumstances. Hence the memory of a series of events that really occurred in a time order or in a spatial arrangement contrary to the usual order or arrangement is peculiarly liable to error.

32. *The omissions, insertions, substitutions and transpositions that affect the accuracy of recall are often quite unnoted by the observer.*

It may appear that this principle is self-evident, that if these errors were noted, they would not be made. In a way this is true, but it must be remembered that the recall of an event may take place with all degrees of confidence in its accuracy—from what is only a shade better than a guess to the most complete positiveness. Thus, a gap in the recall of a series of events might be without serious consequence provided its existence were known and mentioned—if, for instance, the report is made: "I have forgotten just what reply was made to the officer's question"—whereas the same gap might be of serious consequence if it were closed in memory—if, for instance, the report is made: "No reply was made to the officer's question." Similarly, with the other sources of error. The general principle involved is plain enough. What is wanted in a first-class observer is not necessarily a wonderfully detailed memory: rather a cautious memory, a recall in which the possibility of a slip of memory is always kept in mind and in which positive assurance of accuracy is made only with respect to those portions of the report that warrant this assurance.

These facts may be demonstrated by trying again any one of the several tests of memory previously described (the paragraph read, description of the picture or of the persons) and asking each participant in the test to glance over his written account and underline every statement to the accuracy of which he would swear were he testifying under oath in court. It will be unusual if more than half of the participants do not underline at least one statement that is factually wrong. The moral is obvious enough: if under these very favorable conditions—with complete understanding of what was to be done, with a warning as to when the object was to be observed, with no undue fatigue or emotional excitement, with no one to badger or hector by cross-questioning aimed to confuse, with a very short interval between observation and the recording of it—if, under these circumstances, almost every man is liable to swear positively that he recalls something that can be demonstrated to be wrong, then how inaccurate must be the memory of most men under the unfavorable conditions of observing and recalling events that we encounter in daily life, to say nothing of events that are encountered in military reconnaisance observation and patrol work!

33. *The correct recall of one feature of an object or event does not guarantee the correct recall of other features of the same object or event,*

even though these features seem logically bound up in one another. On one of the test-cards often used in laboratory experiments some half dozen different objects are pasted. Among these is a rectangular red label, having a narrow white border and the words "Handle with Care," printed in white letters. It happens often that observers recall that the label was red, but forget its shape; or that they recall that is said "Handle with Care," but report that these words were in black type. Errors of this sort seem almost illogical; that is, it seems as if a correct recall of the words must inevitably be associated with a correct memory of the color of type in which they were printed. But psychologically, it is clear how this last sort of error can occur: the observer may really bring to mind not the original visual picture of the label but his memory of the words as words.

Many people who are ignorant of these facts are too ready to accept the account given by an observer as accurate in its entirety because it is known to be accurate in all those details that are subject to verification. It is true, of course, that if an account states correctly let us say, 23 points with regard to a certain matter and there are stated two more points not open to verification, there is high probability that these two are also correct, but it is equally true that they *may* not be correct.

34. *When a number of persons report upon the same matter, those details upon which agreement appears may in general be considered as correct.* This principle may be demonstrated by reference to almost any of the experiments that have been suggested in the pages that precede. Go over, for instance, the reports made upon the contents of the paragraph, upon the picture or upon the appearance of the persons walking past. Note the statements made by all the observers, by 90 per cent. of them, by 50 per cent. of them, by 10 per cent. of them and by only one observer; see which ones of these statements are correct.

35. *But if a number of persons agree perfectly in their statements about numerous small details under circumstances such that observation must have been difficult and memory of them must have been likely to unintentional error, then suspicion is justified and collusion is probable.* Lawyers and court magistrates are well aware of this principle. When several witnesses tell precisely the same story of the scenes attendant on a riot or assault or murder, for example,

everyone conversant with human nature knows that this sort of agreement is contrary to expectation. It is almost a certain sign that these witnesses have talked over the matter beforehand and have agreed upon the story they have told, or it indicates that the later witnesses have been influenced by the earlier ones and are unable to separate their own memories of the original experience from their memories of what they have heard others tell about it. A corollary easily drawn from this principle is found in the following principle.

36. *When the truth is to be ascertained by the examination of several witnesses of the same event, these witnesses should be examined separately and if possible before they have been able to exchange ideas about it.*

37. *When information obtained by one person is communicated by him to another person a certain amount of inadequacy is almost invariably introduced by the very processes of communication.* Hand to several persons, separately, some familiar object, for instance, a jackknife, a blackboard eraser, a kodak print, a bunch of keys. Ask each one to describe the object so carefully that any one who heard this description would have as good an idea of the object as if he himself had seen it. Let each of the descriptions be listened to at the time or read afterward by another person; ask this last person to make up his mind very carefully just how the object will look, then show it to him and ask him if it differs in the slightest degree from his expectation of it. Was the inadequacy or the mistake due to the verbal description or to the hearer's interpretation of the description. Could it have been avoided? This test can be extended to objects or events of any degree of complexity. Thus, let a group of persons look out of the same window and let one of them describe out loud what he sees, hears, feels or smells, with the idea that he is to make his description as clear and as complete as he can. After, say, a minute of this, stop him and ask others in the group how they would have given the description, *i. e.*, in what respects they would have differed from the account they heard.

Simple experiments of this sort will bring out the following points. In these situations there is practically no reason for discrepancies due to faulty sense organs or distraction of attention or failure to understand what is being observed, nor is there any opportunity for omissions, additions, substitutions or transpositions attributable to faults of memory. Whatever discrepancies do

appear are due to the difficulty of "translating" the objects and events that are correctly enough perceived into suitable words—"suitable" in the sense that they succeed in arousing in the mind of a listener a reasonably complete picture of what is being described. The fault will usually be found to lie in both parties, in the person who is observing and making the statements and in the person who is listening and trying to comprehend these statements.

The same result obtains if the observer tries to use gesture or pantomime or drawings, instead of words or in addition to words, to convey his meaning.

It hardly needs to be added that when this task of communicating information concerns objects or events not under observation at the moment, but merely being recalled from memory, the chances for inaccuracy and incompleteness in the process of "reporting" (as the psychologist terms this process of translating into words) are decidedly increased.

38. *The most prominent inadequacy in description is incompleteness or simplification.* The description of an object is almost invariably simplified, that is, a considerable number of its features, often fairly important features, are not mentioned. It is to be noted that this is quite apart from the tendency to omission due to the fading of impressions in memory, for in such simple tests of ability to report as have just been suggested there is no call for the use of memory at all, but only for description. In one test of this sort conducted by the writer, a photograph was exhibited to a group of observers. Counting all the reports, 22 different objects or features were mentioned, yet the average number mentioned by a single person was only 9.4. Similarly, the French psychologist, Binet, had 150 persons describe a simple photograph and found no two of these descriptions were alike. In another test he asked 36 persons to describe a picture. Of these persons, every one mentioned the old man who formed the center of the group in the scene, but only 29 mentioned the fact that he was lying on a bed; only 27 mentioned a woman seated near him, while only 4 mentioned that one of the children held a stick in his hand. Here we have an illustration of the fact that the more prominent the feature, the more likely it is to be mentioned in any description. That is, the simplification that characterizes all report does not occur in a haphazard manner, but in accordance with a general tendency to put the greatest emphasis on what the observer feels to be most im-

portant and to pass by without mention what he feels to be unimportant. It will be evident, doubtless, how greatly training can improve observation and report in this respect. If the observer understands clearly that things that he once thought to be trivial and meaningless have a high degree of significance, he no longer passes these by without mention.

30. *The attempt to label an observer as belonging to a certain "type" on the basis of what he does in a preliminary trial is of doubtful utility. It is more important to determine his susceptibility to improvement by training.* Students of human nature have sometimes attempted to classify men with respect to their tendencies to report what they have observed in this or that characteristic way. Thus, descriptions have been sorted as displaying predominantly imagination, moralizing, emotional reaction, erudition, simple enumeration, etc. Note, for instance, these two descriptions of a cigarette:

"The cigarette before me has the general form of a cylinder cut at one end by an inclined plane where the paper is folded. The paper, which is striped lengthwise, is somewhat bruised. The tobacco projects about 0.5 cm. from one end," etc.

"We have before us here a cigarette. Let us see how it is made. In the first place the exterior envelope is of light paper, called silk-paper. Then, inside is the tobacco. Tobacco is a product that grows almost everywhere in warm or temperate climates. The leaves of this shrub are gathered, and, after a treatment that lasts four years, are turned over to the public in the form of powder, that is, snuff, or in shreds, as in the present instance." etc.

The first description is listed as the work of a "describer" or "enumerator" because it merely catalogs the features of the object with little attempt at explanation or interpretation. The second description illustrates the work of the "erudite" individual, who tells what he knows or has been taught, rather than what he observes. However, it remains to be determined whether the person who wrote the second description might not write an equally straightforward enumerative sort of description, like that of the first person, if he understood that that was the kind that was wanted,—at least after one or two trials under training and correction.

It will be seen from this comment that one cannot determine by any sort of offhand test what ability a man might demonstrate in a given line of military observation. It was reported early in the war, for instance, that a certain officer engaged men in conversation while he walked down the aisle of a department store with them and then recommended their rejection as aeroplane observers if, without previous warning that they were under test, they could

not give a clear account of the goods displayed on the counters of the store. This story may have no foundation, but if true, it is an excellent example of how dangerous lack of elementary psychological knowledge may be. Failure to pass such a test would indicate nothing of lack of capacity to be trained for military observation. In fact, if it showed anything, a poor score in such a test would simply show that the listener gave such close attention to the officer's remarks as to be oblivious to the mercantile appeal of the bargain counters. Presumably such a man would make good material for training.

We are reminded in this connection of the pompous English school inspector mentioned by Adams, I think in his *Herbartian Psychology Applied to Education*, who asked a class of pupils: "Children, at which end does a recumbent cow begin to arise?" and who, when no response was forthcoming, proceeded to reprimand the trembling teacher for not having taught her charges the fundamental need for comprehensive and accurate observation. What she ought to have said to squelch the inspector was: "Who cares how the recumbent bovine begins to arise, and how does failure to have remarked her *modus operandi* in assuming an erect posture demonstrate that my children cannot observe properly on occasion?"

From what has just been said it must not be supposed that individuals do not display conspicuous and more or less persistent differences in their types of description. They do show these differences, only the differences may be to some extent reduced by special training, and are not in any event to be assumed present on the basis of a single trial under artificial and not clearly understood conditions.

40. *The range and the accuracy of an observer's report depend partly on the form in which it is made, especially whether it be a free, spontaneous account (narrative) or in answer (deposition) to a series of questions (interrogatory).* By a "narrative," in this special sense, we mean a free account, either oral or written, delivered by the observer without comment or suggestion from the person to whom he is reporting. By an "interrogatory" we mean a series of questions designed to probe the observer's memory and to bring out a series of replies concerning the matter in hand. The answers to these questions, we term a "deposition." Of course, the interrogatory may be used alone or it may be used to supplement and to make clearer the statements of the narrative.

Each form of report has its advantages and its disadvantages. Thus, it will be evident that the narrative has the advantage of spontaneity; the observer follows his own trend of ideas and is not influenced in his formulation by any interjections, interruptions or quizzings by those to whom he is reporting. On the other hand, experience shows that the narrative is always of less range than the deposition; that is, the number of items or features that will be voluntarily mentioned, the amount of detail that will be spontaneously reported, is always less than the observer really observes and that he could report accurately in response to properly directed questions. But the corresponding advantage of the deposition, that is, its superior range, is purchased at the expense of a possible disadvantage, because the questioning, as will be shown in a moment, always has a tendency to elicit replies that are less accurate than the statements made in the narrative. Ordinarily, therefore, the observer ought to be permitted to make his own report first and to be interrogated afterward if this narrative is inadequate in scope or obscure in details.

41. *Items recalled by interrogation, though unmentioned in the narrative may often be reported as accurately as other items that were mentioned in the narrative.* It might seem at first thought that if an observer had noted a certain thing so clearly that, on interrogation, he can give a circumstantial description of it, he would naturally have mentioned it in his original recital. The fact is otherwise. It is true that questioning is liable to suggest to the observer matters that he had not observed clearly and that he is liable to make an inaccurate reply about such matters or that he may try so hard to answer every question that is put to him that he may unintentionally falsify. But, on the other hand, there will be a certain percentage of matters that he really did observe clearly and to which he can reply accurately that will be brought out only by the questioning. These matters may have simply slipped his mind when he gave his free version of what he observed and it needs only the barest mention of them to bring them back fully to his memory. Or he may have thought of them but have omitted to speak of them because he felt that they were unimportant.

These principles may be demonstrated by questioning several men who have tried one of the experiments in report that have been suggested in the earlier pages of this Section. Let the narrative be recorded; then quiz the men concerning items they have omitted,

e. g., "Was anything said about fish nets in the description of the Dutch homestead?" "Was there a piece of paper on the floor of the room you are describing?" etc.

42. *The amount of error in the deposition depends much on the skill with which the questions are framed: it is considerably increased if the interrogatory contains suggestive questions.* Everyone knows that a skillful questioner can go far toward bringing out replies of the sort he desires. Lawyers who wish to trap a witness into making a given statement often resort to "leading" questions unless the opposing counsel or the judge raise objections. If an officer is "pumping" a patrol leader for information he has no wish, of course, to encourage inconsistent or false statements, yet he runs that risk if he is not careful of the way he puts his questions.

Of the various types of questions it is worth noting a few of the most common.

The questioner ought, therefore, to be familiar with a few of the most common types, or forms, of questions and to know roughly which of them is the least, which the most misleading to the reporter.

Let us suppose that the reporter is being quizzed about a picture in which there was a brown dog but no cat.

(*a*) The question: "What color is the dog?" carries the least amount of suggestion. The reporter is free to mention any color. Questions thus introduced by a pronoun or by an interrogative adverb may be called *determinative* questions.

(*b*) The question: "Is there a dog in the picture?" is a *completely disjunctive* question. It forces the reporter to choose between two alternatives.

(*c*) The question: "Is the dog white or black?" is an *incompletely disjunctive* question. It offers the reporter a choice between two alternatives, but does not preclude a third possibility. Under the circumstances we are assuming, this question would be distinctly a suggestive and misleading question. The reporter can, of course, reply: "Neither, it is brown," but this reply necessitates a certain degree of resistance to the suggestion that the dog is either white or black.

(*d*) The question: "Was there not a cat in the picture?" is termed an *expectative* question. It obviously arouses a fairly strong suggestion that the answer is to be "Yes."

(*e*) The question: "What color is the cat?" would be an *im-*

plicative question under the conditions we are assuming, because it implies the presence of a feature that was not really present in the experience. Its suggestiveness is usually much stronger than that of the expectative or disjunctive type of question; that is, for the average observer, if he is not certain whether the cat was there or not, it is much harder to say "There was no cat" in answer to this question than in answer to the question: "Was there a cat in the picture?"

It would be well for students to practice the phrasing of questions relating to some experimental situation. Let one member of a class observe a large complex picture or a group of objects on a table or a bit of terrain containing numerous features of military significance. While his eyes are closed let other members of the class practice in quizzing him on what he saw, aiming now to produce suggestion, now to avoid suggestion, as may be directed. Let others criticize the formulation of the questions in the light of the aim of the questioner.[5]

The actual degree of influence exerted by suggestive questions may be indicated by some quantitative results obtained by Binet with his "Card of Objects" test. With indifferent (non-suggestive) questions he obtained 26 per cent. of error, with moderately suggestive questions (mostly of the expectative type) 38 per cent. of error and with strongly suggestive questions (mostly of the implicative type) 61 per cent. of error. These figures pertain to results with children, who are well known to be more open to suggestion than are adults, but the relative influence of the different types of questions may be deemed about the same for children and adults.

43. *If by an error is meant any distinct discrepancy between items reported and the actual facts, it may be laid down as a rule that, even in the case of competent adults, observing and reporting under favorable conditions, an errorless report is the exception. On the contrary, if the report attempts to get down to details, the average reporter will make a score of about 75 per cent. in accuracy, not counting omissions as errors.* This statement is based upon repeated trials under experimental control in the psychological laboratory. In such

[5] If the lithograph previously suggested, known as "The Disputed Case," or if the Binet "Card of Objects" are either of them available, questions of varying degrees of suggestiveness will be found on pp. 23–24 and 27–29 of the writer's *Manual*, Part II., Test 32.

trials the conditions are uncommonly favorable—the observer knows what he is to observe, when it will appear, how long it will be perceptible, and understands that he is to make a report almost immediately afterward. Observers who must do their work under markedly less favorable conditions certainly cannot be expected to make much better scores.

The few exceptional reports that are errorless are usually found to have only a very small range. That is to say, it is possible to make a score of 100 per cent. in accuracy by refusing to make any statement that is not felt to be positively correct. Indeed, in some instances of this sort that have come to my notice, the report was so much restricted in order not to make an error that it was almost valueless as a conveyor of information.

The practical significance of this principle is that every piece of testimony must be accepted with caution. If you are an officer and if your men make to you a series of reports that run at all into detail, you may be sure that the chances are better than one to one that there is at least one mistake in each man's report.

44. *If the various items that constitute a report are sorted by the reporter into groups according to the degree of certainty he feels as to their accuracy, then the items in the group characterized by the highest degree of certainty will be found to be distinctly more accurate than those placed in other groups, but a first-class, highly trained observer will at times be absolutely wrong with respect to statements to which he attaches the highest degree of certainty.* In illustrating Principle 32 (that slips of memory are often unnoticed) it was suggested that the report of the paragraph read or of the picture or persons seen be marked to show what items would be sworn to as correct, with the reporter giving testimony in court under oath. It is to statements like those underlined in that experiment that we refer to as "items in the group characterized by the highest degree of certainty." In laboratory experiments, when all statements are divided into two groups—those "sworn to" and those not—the items in the former group usually contain about 10 per cent. inaccuracy as over against some 20 to 25 per cent. inaccuracy in the latter group. It is possible to distinguish more than two degrees of certainty; it is not difficult, for example, to grade each item in your report on a scale of five points: (1) absolutely positive, (2) very certain, (3) fairly certain, (4) doubtful, (5) little better than a guess. If this is done by the members of a class and if the number

of errors are counted for items reported with each of these five degrees of certainty, it will be found that the proportion of errors tends to increase as the degree of certainty decreases.

The practical application of this principle is not far to seek. Men who are being trained for work in intelligence sections ought to understand thoroughly that error tends to be inversely proportional to certainty, and they ought to be encouraged to qualify their reports by indicating the degree of certainty attaching to important items. Thus, their reports should contain such phrases as: "I am positive that" so and so; "I am fairly sure that" so and so; "I am inclined to think" so and so; "I overheard only snatches of conversation and can only hazard a guess that" so and so.

45. *Estimates of distances, heights, angles, numbers and dimensions of objects are open to considerable inaccuracy and are often subject to constant tendencies to over or underestimation.* It is rather hard to lay down precise rules to cover the detailed application of this principle; so much depends on special conditions. But in general we find that short time-intervals (in the neighborhood of one minute) are strongly overestimated; intervals of medium length (about 10 minutes) show no overestimaton, while longer intervals (30 minutes) are usually underestimated. Short distances (2 or 3 meters) and long distances (over 100 meters) are usually somewhat underestimated, while medium distances (around 20 meters) are often overestimated. The angular grade of hills and roads is strongly overestimated. All these and similar estimations, like estimates of the number of men in a crowd, are considerably affected by the accident of their relation to the nearest "round number," or rough unit of estimation. Thus, a person weighing 208 pounds and another weighing 194 pounds, if estimated singly, are very likely both to be set down by most estimators as weighing 200 pounds, that being the nearest convenient round number, so that the former's weight will be consistently underestimated, the latter's consistently overestimated. In the same way a stretch of time is more apt to be reported as five minutes than as four minutes or six minutes.

It will be seen from these considerations that in this matter of estimating quantities agreement among witnesses may mean little. In this case it is not true that the report given by the majority of witnesses is almost certainly correct. For example, if a series of striking events occurred in rapid succession that occupied just one

minute, it is not likely that any participant would estimate their duration at less than five minutes.

The way to meet these difficulties is evidently to practise the men selected for observation in the making of all the estimates that they are likely to have to make in their work. The intelligence section, for example, ought during its period of training to make frequent trial in estimating distances, numbers of men grouped in the distance, etc., with immediate correction by the officer in charge. As, for instance: "How far from here to that tree stump?" "Forty paces." "No, sixty five paces; walk over there and back and get the feeling of sixty five paces fixed in your mind." "How many men are seated on the ground at target practice?" etc.

There is some ground for believing that persons of poor culture, unless their occupation has led them to receive special practise in this sort of work, are distinctly inferior to persons of good culture in all sorts of estimations. It would certainly seem probable that the possession of a good degree of general intelligence would be a helpful aid in the quick response to training in the making of accurate estimations.

GENERAL REVIEW AND SUMMARY

READING

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The larger number of investigations of reading in the past two years have been concerned with the devising of tests and the results of their application to school children.

The relation between speed and quality of reading has been studied by King (4), (5) and Peters (7). The former finds little ground for the view that the efficiency of fast readers is greater than that of slow readers; and the latter, that increased speed does not necessarily carry with it any increase in efficiency. On the other hand, Peters finds that 18.7 per cent. of pupils gain in both speed and effectiveness by special speed drills.

Whipple and Curtis (12) investigated the capacity of six university students to reproduce material read by the process of skimming at normal and forced rates. The slowest readers were found to be the poorest reproducers, and the best reproducer was a fast, but not the fastest, reader. Fast skimming is correlated with poor reproduction. The natural rate of skimming is correlated with that of reading, and the conclusion is drawn that skimming should be taught.

Thorndike (10), (11) has studied the process of acquiring meaning in reading by a study of answers to questions on the material read. He finds certain words to be overpotent and others underpotent in their effects. When errors occur, elements have become dislocated, or connections are wrong or inadequate. Reading for content is essentially thinking, and the results show that reasoning is explicable on the basis of the general laws of habit.

Mead (6) finds that 70 per cent. of pupils investigated reproduce material read silently better than material read orally.

A revival in interest in the study of eye-movements in reading is evinced in the work of Schmidt (8) and Judd (3). Schmidt used the Dodge method in comparing the eye-movements in oral and silent reading. He found that the pauses are more frequent and of

greater duration in oral reading, as well as that the perception time is significantly greater.

Judd's important mongraph is a comprehensive study of reading from the genetic point of view. Besides the editor's independent work it utilizes the work of C. T. Gray (1), W. S. Gray (2), Schmidt (9) and others. The eye-movements of both adults and children, good and poor readers, have been studied in both silent and oral reading. Experimental methods of training children who are backward in reading are described.

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SPECIAL REVIEWS

The Stanford Revision and Extension of the Binet-Simon Scale for Measuring Intelligence. L. M. TERMAN, GRACE LYMAN, GEORGE ORDAHL, LOUISE E. ORDAHL, NEVA GALBREATH AND WILFORD TALBERT. Baltimore: Warwick & York, 1917. Pp. 179.

A Scale of Performance Tests. R. PINTNER AND D. G. PATERSON, New York: Appleton, 1917. Pp. ix + 217.

The Picture Completion Test. R. PINTER AND MARGARET M. ANDERSON, Baltimore: Warwick & York, 1917. Pp. vii + 101.

The Mental Survey. R. PINTNER, New York: Appleton, 1918. Pp. v + 116.

These four books represent the best type of recent work in the accurate standardization of mental tests. The technique of standardization is a very recent development. One has only to compare the elaborage and careful work on the Stanford Revision, which is described in Terman's manual, with the comparatively crude method by which the original Binet Scale was constructed to realize the advance which has been made in the past ten years. The Stanford investigation stands preeminent in the testing movement as a piece of standardizing work. It was carefully and adequately planned after preliminary experience, the subjects were numerous and representative, and the material of the scale was worked over on the basis of the results until the scores met the requirements of an accurate, relatively final standard. The standardization was not left in tentative form, but was worked over until the median of unselected children tested at the age corresponding to their chronological age. This investigation stands as a model in this respect and as an example which other investigators would do well to follow. Even the careful and ingenious work of Pintner, represented in the other books under review, is marred by the fact that it stops short of this completeness of standardization. It is legitimate to put out results as tentative when it is necessary to get the coöperation of other investigators in order to check them up, but when the investigator has the material in his own hands to carry the work forward to completion it is a pity when he does not do so before publishing

them. Pintner has carried his work so much further than have most investigators, and has displayed so much skill in the statistical formulation of his results, that we may well demand of him the one final step necessary to complete standardization. This applies particularly to the Scale of Performance Tests, which might have been standardized by determining the arrangement or method of scoring which would make the median unselected child test true to age.

The readers of this journal do not need to be introduced to the details of the Stanford revision. It is a radical modification of the Binet Scale. The old tests and many new ones were standardized by giving them to about 1,000 children in a middle class community. The final scale numbers 90 tests as compared with 54 of the Binet Scale. The scoring is modified so as to read in months of age, and the various factors which make up the score have been adjusted empirically in order to make the scale true. These factors are the number of years for which tests are furnished, the number of tests for each year, the score value of each test, and the hardness of the individual tests as measured by the percentage of children passing it at the age at which it is set. These factors, which may be modified so as to make the scale harder or easier, were changed three times, and each time all the records were scored, before the results were satisfactory.

Terman takes the opportunity in this monograph to discuss problems relating to the validity of the general organization of the age scale, particularly as compared with the so-called point scale, and questions relating to the interpretation of the scores, and to norms. With reference to the age principle the author clearly indicates that it is only a question of method. A point scale uses the age development principle in its norms, and an age scale can be made into a point scale by putting its scores into the form of ratios. The age scale as at present constructed has the advantage in that the weighting of the different tests is determined empirically rather than arbitrarily. The interpretation of the scores is involved in the question of norms. Sex differences are not great enough to require separate norms. Whether social differences require different norms depends on whether they are due to environmental or inherent differences. They are probably in part at least inherent, and therefore do not require as widely different norms, as is indicated on the face of the scores.

Pintner and Paterson's *Scale of Performance Tests* is constructed

for the purpose of making it possible to test children who cannot be tested by the Binet Scale on account of language limitations, or to supplement the Binet Scale. The tests are chiefly of the form board variety, with the addition Healy's Picture Completion Test, the Substitution Test, Goddard's Adaptation Board, and the Knox-Pintner Cube Test. These tests were given to from about 650 to nearly 1,000 children each, and were scored for time and errors. Time and errors were used separately for the norms. The results are worked up so as to give three kinds of scales, an age scale, a median age scale, and a point scale.

The age scale is similar to the Binet scale except that instead of scoring each test for the most part by the pass or fail standard and then assigning a test to one mental age, several age standards are laid down for each test by determining a range of scores to correspond to each age. This range consists of all the scores between that attained by 75 per cent. of the children of the age in question and the score attained by 75 per cent. of the children of the next higher age. The 75 per cent. standard is adopted on the theory that it will include all the scores made by the middle 50 per cent. of children of a given age and hence all those who are to be reckoned as normal. Theoretically it is probably better to standardize the scores for individual tests by assigning to a particular age the score made by the median child of that age, but the question is not simple.

After the age scores for the individual tests are determined they are put into three kinds of scales. The first is an age scale of the same sort as the Binet Scale. Since there are not an equal number of tests for each age the tests for a particular age are weighted by giving each test a value equivalent to its ratio to the total number of tests for the age. Thus if these are ten tests for an age each test has the value of one tenth year. With this qualification the scoring is done as in the Binet Scale.

The second scale, which the authors recommend, is a median age scale. According to this method a child's mental age is first determined in each test individually and then his total or true mental age is found by taking the median of the individual mental ages. The calculation is thus not affected by the number of tests which are used for each mental age nor by the number which are given the child, so long as there are enough to make an adequate test.

The third scale is a point scale. The chief problem here is to determine how many points should be assigned to each test. The authors adopt the method, which they recognize as not very satis-

factory, of assigning approximately the same number of points to each test. They then, on the basis of the age progress curve, count somewhat arbitrarily the number of discriminative steps in the entire scale of performance which appear, and assign to each discriminative step the score which is found by dividing the total score by the number of steps. Since the process is not recommended by the authors themselves it is not necessary to describe it further.

Specimen record blanks, and the records of two children based on the three performance scales and the Binet Scale are given. There is considerable discrepancy between the rating by the different scales but the authors do not determine which is the truest.

The standardization of the picture complexion test is a very elaborate and complete piece of work. Every move made by a large group of children was recorded and the percentages of the various moves were calculated. These percentages were used as the basis of the weighting of the various moves in scoring them. Instead of arbitrarily deciding that certain moves should be given full credit, others partial credit and still others no credit each move which occurred at all was rated as deserving an amount of credit proportional to the number of individuals who made it. After all the moves were thus rated it became a simple matter to calculate an individual's score by adding the credits of all the moves which he made in placing the blocks. This empirical method of standardization, while it may require modification in detail, is in principle much superior to the a priori method which has been much more frequently employed. After determining the method of scoring the authors calculated the ten percentile scores of the children of each age. This makes it possible to use the test in scales in a variety of ways. It is a method which was introduced into the field of tests by Mrs. Wooley and promises to be very serviceable.

Pintner's *Mental Survey* was prepared to be a manual for group testing. A small group of tests, most of which were included in Pyle's manual, have been standardized by the ten percentile method. The method is an excellent one and it is very desirable that it be extended, but it would have been more suitable to put out the present list as an illustration of the method than as a manual. Before a manual is put forth a more extensive and careful selection of tests should be made. Some of the tests included in the present list are of little value and others of greater value might have been included. Premature publication of a manual for general use leads to the dissemination of error through faulty experimentation by

persons who are not qualified to criticize their method of procedure. Furthermore, in view of the present scarcity of labor and materials it is more than ever necessary to make sure of the serviceableness of a new and expensive book before publishing it. The material of this book would be valuable an an inexpensive technical monograph, but not as an expensive manual for general use.

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NOTES AND NEWS

DR. H. E. BURTT has been appointed instructor in psychology at Harvard University.

DR. JOHN J. TIGERT, head of the department of psychology at the University of Kentucky, has been granted leave of absence and will go at the close of this year to France into Army Y. M. C. A. work.

UNDER date of May 11 the President has issued an executive order requesting the National Academy of Sciences to perpetuate the National Research Council with specific mention of the following duties: 1, to stimulate research; 2, to formulate comprehensive projects; 3, to promote coöperation in research; 4, to bring about coöperation of investigators with the War, Navy and other civil U. S. government departments; 5, to direct attention to the importance of military and industrial problems; and 6, to gather and disseminate scientific and technical information to those duly accredited.